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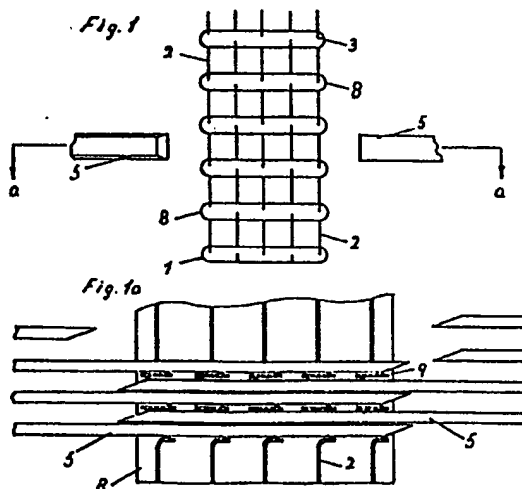
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54 Heat exchanger elements and method of manufacturing.

57 Heat exchanger elements comprising a number of parallel, hollow shapes (1) interconnected by a plurality of integrally extruded webs (2) which is provided with a number of perforations resulting in a number of transversely disposed ribs (9).



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Heat Exchanger Elements and Method
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The invention relates to heat exchanger elements and more particularly to hollow shapes for heat exchangers, a tube bundle comprising one or more hollow shapes and a procedure for manufacturing hollow shapes and tube bundle. The specially designed hollow shapes are integrally extruded and each comprising a number of tubes with a plurality of thin inter-connecting webs or lamellae between the adjacent tubes.

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out → Heat exchangers comprising a plurality of parallel tubes projecting into headers and forming a heat exchanger unit (element) are at present mainly made of aluminium or copper tubes with interjacent lamellae, which are mutually connected in order to establish a heat-conducting connection.

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out The connection between tubes and lamellae can be obtained by soldering/brazing or welding, and to facilitate this operation the tubes or lamellae are plated with e.g. AlSi alloy which during a subsequent heating of the assembled heat exchanger melts, thereby ensuring a reliable, firm connection.

In the case of heat exchangers which are made up of flat or flat oval tubes, brazing or soldering has until now been the only possible connection method. When using tubes with a circular cross-section, a simplified connection method has been established. Here the heat exchanger is assembled using specially formed top and bottom headers, after which the tubes are given a permanent deformation mechanically or under pressure, by expansion against the limiting lamella sides.

Such an assembly method is however not possible in the case of flat, oval tubes, as these cannot maintain the contact pressure against the lamellae over the whole circumference.

Soldering or brazing of the individual tubes is however a highly labour-intensive and cost-adding operation, and although using expansion of the individual tubes does not result in a connection of the same quality and strength, something which reduces the efficiency of the heat exchanger, it is nevertheless this latter method which is presently primarily used in the manufacture of heat exchangers.

The object of the invention is to provide tube and lamella (fin stock) connections which are always reliable and firm without using plated tubes and lamellae with a subsequent soldering/brazing operation.

It is further the object of the invention to produce such connections which are equally effective, regardless of whether the tubes are of flat, oval, elliptic or round cross-section.

Another object of the invention is to manufacture hollow shapes with such tube and lamella connections, where the hollow shapes can easily be joined together to form larger units.

Finally it is the object of the invention to provide a method of the manufacture of hollow shapes with specially formed integrated webs resulting in an optimal heat-conductive surface.

These and other objects of the invention are achieved using embodiments which are defined in the accompanying claims 1-5.

The invention will be described more explicitly with reference to a special embodiment which is shown in the drawings, Fig. 1-4, where

Fig. 1 shows in schematic form a section view through a heat-exchanger shape according to the invention, which is subjected to a perforation operation.

Fig. 2 shows an enlarged section of the same.

Fig. 3 shows the principle for joining a number of shapes to form a tube bundle, composed of flat single tubes.

Fig. 4 shows the joining of hollow shapes formed as circular tubes.

The hollow shapes according to Fig. 1 comprise a number of flat tubes 1 which are mutually joined by thin lamellae or webs 2. A single tube and connecting webs are shown on an enlarged scale in Fig. 2. The individual flat tubes 1 can have a number of inner fins or small ribs 3 to increase the internal heat-transfer surface. As stated above, a number of thin webs 2 connect the adjacent tubes with each other.

The tubes and webs have been extruded in one piece and the wall thickness of the hollow shape has been adjusted according to the pressure at which the heat exchanger is to operate.

The tubes' narrow ends or edges of the heat exchanger element will be positioned in the direction of air circulation, and in order to obtain an optimal heat exchange between the media, e.g. air over the webs and water through the tubes, efforts must be made to alter the shape of the webs in such a way that optimal distribution with maximum turbulence is achieved for the air which is to pass between the tubes.

After extrusion the webs 2 are therefor mechanically perforated or slit and at the same time deflected so that transverse single lamellae or ribs 9 are formed, which run across the original webs 2. In this way the transversally disposed lamellae will maintain full metallic contact with the webs, and simultaneously through the perforated openings in the webs it is allowed for the transverse air flow between the tubes. This completely avoids soldering, brazing, expansion etc., and there will be no reduction in the efficiency as has been experienced after a certain amount of time with conventionally connected fin stock types as a result of corrosion, vibration and the like. Perforation and deformation of the webs can be obtained advantageously using a simple cutting or punching tool 5. This can be effected from one side or from both sides, and the deformation or deflection degree can be varied in the same way as the size of the perforation can be varied depending of the shape of the tool which is used.

Fig. 1 suggests an arrangement for perforating and deflecting using a single cutting device 5 which can operate from one side or double cutting device 5, 5 which operates from both sides. Fig. 1a shows a section taken along the line a-a in Fig. 1 and illustrates a possible embodiment of the perforation pattern. The shape of transverse lamellae formed when the punching tool is pressed through the web walls can therefore be varied practically just as desired, since, as mentioned above, perforation can be done from one side or from both sides at the same time as the vertical spacing between each perforation can be varied.

With this special manufacturing method for hollow shapes, it is possible to select flat and oval tubes cross-sections with optimal heat-transfer characteristics. This in turn makes it possible to build compact heat exchangers. It is assumed,

however, that in some cases it is necessary to build larger heat exchangers with tube bundles which comprise a number of elements (hollow shapes) according to the invention.

Figs. 3 and 4 show how this is done in practice. The individual hollow shape 10 and 11 is extruded with e.g. mortice and tenon part 12 and 13 of an advantageous form. Each hollow shape is formed with three parallel webs 14.

Fig. 3 shows a hollow shape comprising flat tubes according to the embodiment in Fig. 1. The next to outermost tube in a hollow shape here has a semicircular hollow key 12 which is designed to (fit) into a correspondingly formed hollow key 13 in an adjacent shape. The figure shows two hollow shapes in their joined state and the joining can of course be continued to produce a tube bundle of the desired size and form.

Fig. 4 shows a corresponding joining principle used on hollow shapes where the individual tubes are circular and formed with only two interjacent, unbroken webs 15 and 15' and a middle lamella which is formed as a bisected rib 16 and 16'.

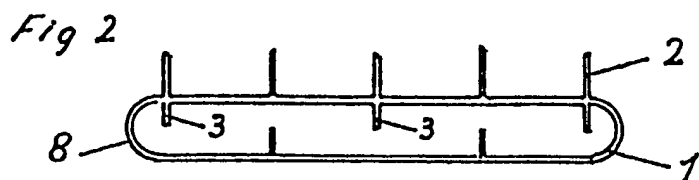
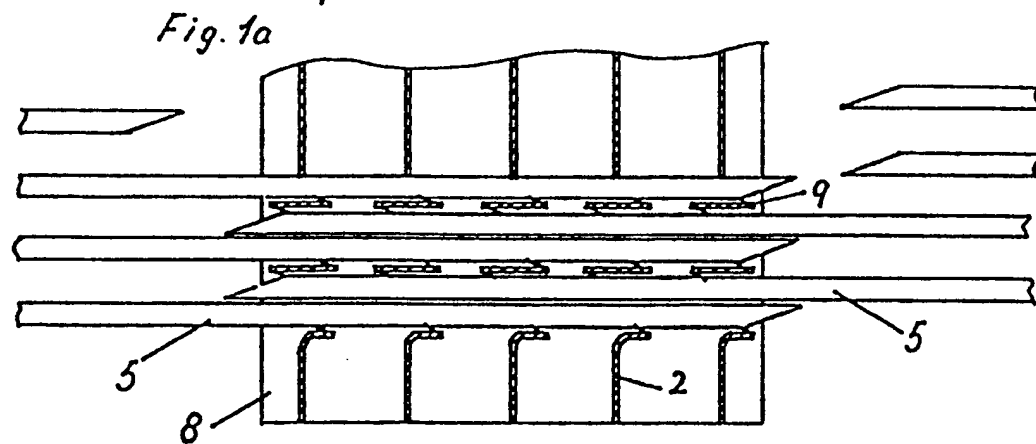
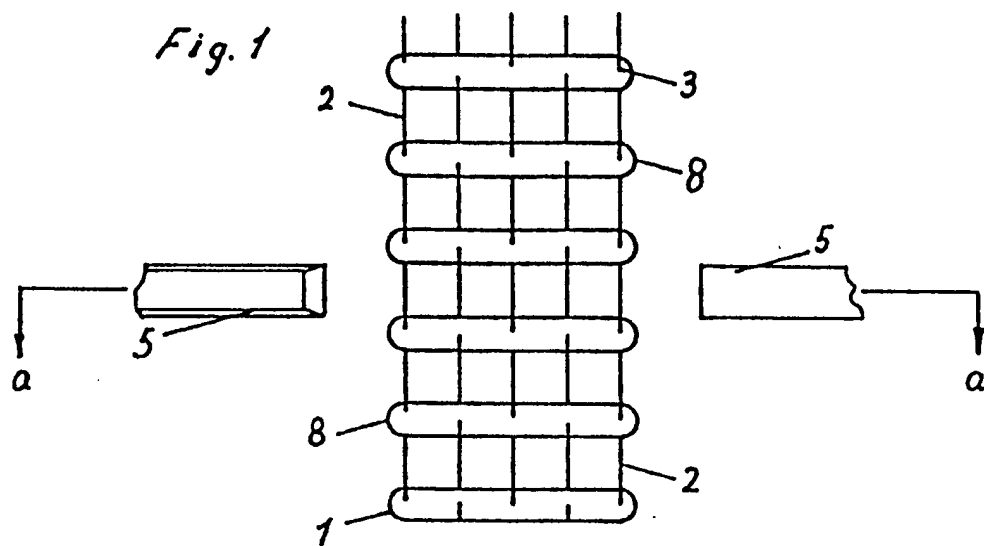
The number of webs and tubes, their shape as well as the means used for joining can, however, be varied in other ways within the scope of the invention as defined in the patent claims, e.g. the webs could run in a zig-zag pattern between the adjacent tubes and not mutually parallel as illustrated by the accompanying drawings.

Claims

1. Heat exchanger elements for the manufacture of heat exchangers and tube bundles for heat exchangers comprising a number of tubes which are mutually connected by means of interconnecting webs integrally extruded with the tubes,
c h a r a c t e r i z e d i n t h a t
the said tube (1), which can be of circular, oval, elliptic or flat oval cross-section, are connected by means of a plurality of thin webs (2) running parallel to the tubes' longitudinal axis, whereby a heat-transfer surface is formed with the tubes which can be increased proportionally with the number of webs and the distance between the tubes.
2. Element according to claim 1,
c h a r a c t e r i z e d i n t h a t
each web (2) is formed with a number of perforations and that the material in the area between each perforation has deflected parts (9) which lie at an angle to the web's plane surface.
3. Element according to claim 2,
c h a r a c t e r i z e d i n t h a t
the shapes (10, 11) are provided with a joining track (12, 13) which enables the joining of a number of hollow shapes side by side or on top of each other.
4. Tube bundle for heat exchangers made of elements according to claim 1, 2 or 3,
c h a r a c t e r i z e d i n t h a t
it comprises a number of hollow shapes (10, 11) which are joined together one behind the other and/or one beside the other, whereby an integrated tube bundle of the desired size and volume is obtained.

5. Method of manufacturing hollow shapes for heat exchangers according to any of the claims 1-4, characterized in that a hollow shape is extruded comprising a number of parallel tubes (1), which are interconnected by means of a number of parallel webs (2) running parallel to the tubes' longitudinal axis, and that the lamellae are thereafter perforated while at the same time being deformed by punching, cutting or the like.

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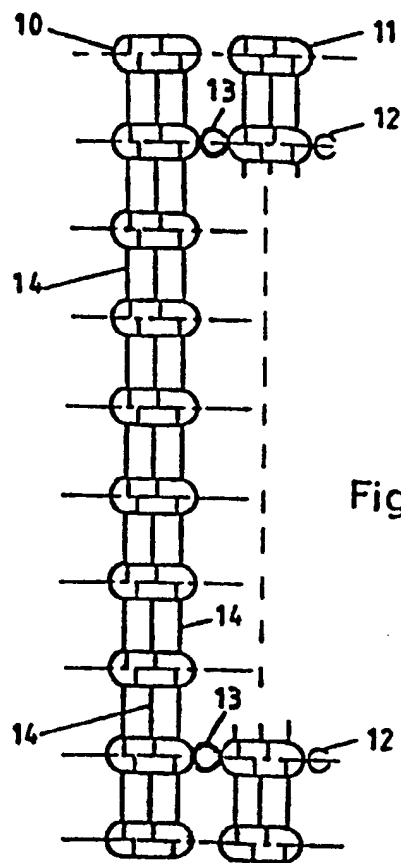


Fig. 3

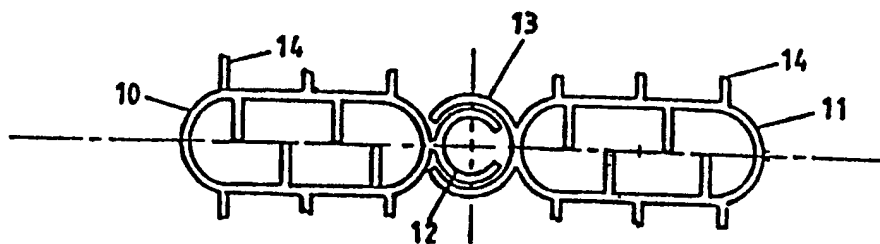


Fig. 3a

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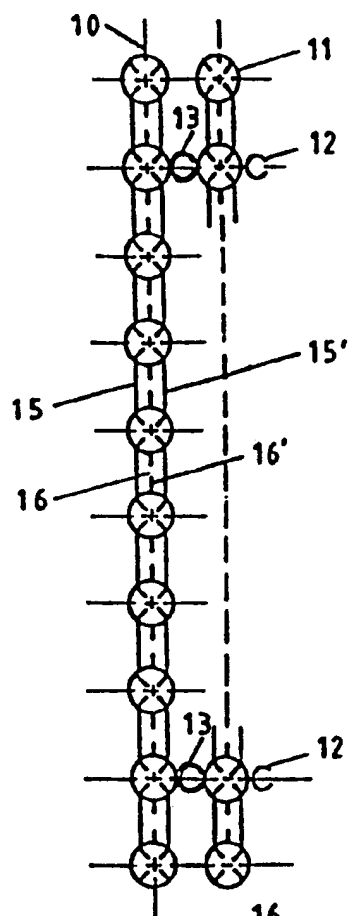


Fig. 4

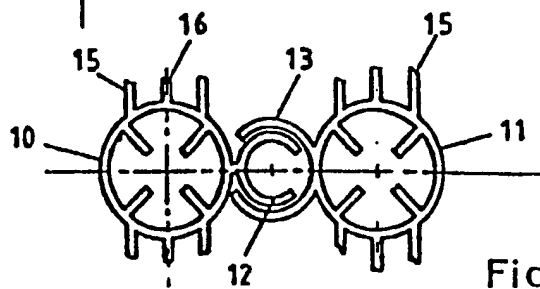


Fig. 4a



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EUROPEAN SEARCH REPORT

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Application number

EP 85 11 3011

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl. 4)
Y	US-A-4 071 934 (ZOLMAN) * Column 1, lines 11-22; column 2, lines 17-67; column 3, lines 21-29; figures *	1, 4, 5	F 28 F 1/22 F 28 F 1/02 B 21 C 23/10 B 21 C 37/20 B 29 C 69/00 F 16 L 3/22
A		2	
Y	FR-A-1 496 559 (REVERE) * Page 2, column 2, lines 10-22, 36; page 3, column 1, lines 23-38, 51-57; figures 4, 7 *	1, 4, 5	
A		3	
Y	US-A-2 347 957 (McCULLOUGH) * Page 1, column 1, lines 1-14; page 3, column 1, lines 10-23; figure 12 *	1	TECHNICAL FIELDS SEARCHED (Int. Cl. 4)
Y	FR-A-1 048 568 (METALLGESELLSCHAFT) * Page 1, column 1, lines 25-40; page 1, column 2, line 42 - page 2, column 1, line 13; page 2, column 1, lines 31-35; figure 4 *	1	F 28 F B 21 C F 16 L
The present search report has been drawn up for all claims			
Place of search THE HAGUE		Date of completion of the search 22-01-1986	Examiner KLEIN C.
<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>			



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0179381

Application number

EP 85 11 3011

Page 2

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0179381

Application number

EP 85 11 3011

Page 3

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A	WO-A-8 200 344 (SUPERCOOL)		

A	PATENTS ABSTRACTS OF JAPAN, vol. 7, no. 257 (M-256) [1402], 16th November 1983; & JP - A - 58 138 993 (MATSUSHITA DENKI SANGYO K.K.) 18-08-1983		

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